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Manual for Forest Fire
Fighters Service

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State Council of Defense
(Pa.)
Manual for Forest Fire
Fighters Service

MANUAL

FOR

FOREST FIRE FIGHTERS SERVICE



STATE COUNCIL OF DEFENSE
Commonwealth of Pennsylvania
HARRISBURG

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FOREWORD

This manual is a summary and compilation of the best available material for the Forest Fire Fighters Service. The many volunteers who will participate in this new unit of Civilian Defense will be a valuable asset to the staff of the Councils of Defense in Pennsylvania.

The purpose of this manual is to present to those volunteers an adequate program of training that will best serve the needs of the service for Civilian Defense. No definite schedule of hours has been formulated for a training course. However, it is hoped that sufficient time will be devoted to the study of this manual to guarantee the minimum requirements. Instructors will find this manual useful in the presentation of the training program.

The protection of forests in the Commonwealth of Pennsylvania is of paramount importance. Forest protection is a community welfare proposition. During war-time, when timber needs for war purposes exceed peace-time needs, it is doubly important that men prepare themselves for Forest Fire Fighters Service. It is an important function of Civilian Defense on the home front.

This manual was prepared by George H. Wirt, Chief, Division of Protection, Department of Forest and Waters, Commonwealth of Pennsylvania, and Director of Forest Fire Fighters Service for the State Council of Defense. It was reviewed and edited by staff members of the Public Service Institute, Department of Public Instruction, Commonwealth of Pennsylvania.

R. Chapman Carver, Chief of Training
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State Council of Defense

March, 1943



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Chapter I

OBJECTIVE—PROBLEM

Forest fires destroy natural resources which are of immediate value to every person in a forest community or in a State having a considerable area of forest land. Protected and managed forests are productive, not only of wood and bark, but also of many indirect values. In order to keep the forests productive, fire must be kept out of them.

Every man, woman and child should know that fire is dangerous and that it must be constantly kept under control, especially out-of-doors. To prevent a fire is the easiest way to keep from having one to extinguish, but we know it will be some time before everybody will be careful. Fires will occur. It is necessary, therefore, to furnish for some of our citizens instructions in the procedure necessary to effectively organize forest fire fighting forces and equipment to attack, control and extinguish fire with the following objectives in view:

1. The prevention of fire spread as rapidly as possible.
2. The confinement of fire to smallest possible area.
3. The complete extinguishment of fire with a minimum of damage and expense.
4. The preclusion of further outbreak possibilities.

In Pennsylvania, there are 13,000,000 acres of forest land which must be protected from fire. There are many days each year when every square foot of this large area, almost half the total land surface of the State, is dry as tinder. Fire can start on a rampage from the least spark. Through this large area, our ten millions of people walk and ride, work and play. Millions of visitors add to the chances of fires starting. Many of these millions of people are smokers who discard matches and cigarettes without realizing the danger of fire or knowing that the leaves and other vegetable matter are easily set on fire. Hundreds of them want camp fires but do not know how to keep the sparks from spreading everywhere. Thousands of farmers and others cleaning up fields, fence rows, gardens, cabin sites, or just burning rubbish, start a fire and then forget about it, or cannot control the sparks. Miles of steam railroad tracks run through forested regions, and sparks do come from engines. If the sparks are hot enough, and the leaves on the ground dry enough, a fire starts.

With this vast forest area, and with a large population, there are bound to be many careless people and, in consequence, many forest fires.

These forest fires destroy values which no people can afford to lose during ordinary peace times. During war times, when timber needs for war purposes exceed peace time needs, it becomes an offense against the United States at war to start a forest fire, or to permit it to destroy timber. In addition to that, the labor of every man and

woman in the country is needed for the war effort. Every destructive force which takes labor from constructive work, and which must be controlled, is equivalent to an act of sabotage by an alien enemy.

The Commonwealth of Pennsylvania, during the past twenty-five years, has been developing a program looking to the elimination of forest fires and consequent damage from fire. An organization of forest fire wardens and forest fire fighters has been developed. Considerable progress has been made, but much remains to be done. However, we are now in the war. Men have been taken from our forest protection force by the armed forces of the country, and others have gone to war production industries. There is a possibility that the forest fire risk which normally exists will be increased by the activities of enemies.

Because conditions with respect to forests and fire in Pennsylvania are present in every forest region within the United States, and because of the importance of forests in our war effort, the President of the United States directed that there should be set up a Forest Fire Fighters Service in the Civilian Defense Organization as a Volunteer Auxiliary to the regularly established State forest protection organization.

Chapter II

WHEN FOREST FIRES OCCUR

Forest fires have occurred in Pennsylvania on practically every day of the year. Because the vegetable matter on the soil within a forest area is easily burned when not completely soaked with water, forest fires may occur when the ground is not covered with snow or when it is not raining.

Every condition which favors the drying out of the forest floor, comprised mostly of leaves and dead branches, favors the starting and spread of fire. In the first place, it must be remembered that dead vegetable matter readily absorbs moisture and just as readily gives it up.

In our hardwood forests, the leaves die and begin to fall from the trees usually about the middle of September. Frequent or heavy frosts hasten the fall. As the leaf cover of trees thins out, the sun and wind can reach again the material on the ground and dry it out. Everyone knows how leaves burn when they are raked up from under shade trees.

Frost and dew in the evening, during the night, and in the morning, as well as rain during the fall of the leaves, lessen the period of day during which dead leaves are dry enough to burn, but evaporation is rapid under the effect of sun and wind. A little heat from a fire, once it is started, dries out the fuel ahead of it and permits the fire to spread easily.

From the time the trees begin to lose their leaves in autumn until they are in full leaf again in April or May, and spring rains have

thoroughly wet the mulch cover of forest soil, the sun and wind are active, except when snow covers the forest floor, or when it is snowing or raining. As soon as the winter snows melt, the winds of spring increase, and the heat of the spring sun increases as the days grow longer. Frost and dew at night becomes less frequent, and it is in April and May that the vegetable matter on the forest floor becomes like tinder. The least spark starts a raging fire.

After the leaves are full grown, their shade protects the ground from the sun and wind, and evaporation is materially reduced. The rain distribution is usually sufficient to keep the vegetable material moist and, therefore, fires do not start easily. A spark may fall on the leaves, but they are moist enough to resist the heat and, consequently, do not burst into flame.

Of course, a scarcity of rain for several weeks or a month during the summer season, may be sufficient for the forest floor to dry out, and then, during the hot days of summer, fires may rage again.

The periods of forest fire danger and proportional prevalence of fires, as determined by past experiences, are shown by the graph on page 8.

Chapter III

CAUSES OF FOREST FIRES

Before anyone can do very much toward the prevention and elimination of forest fires, he must know something as to how and why forest fires occur.

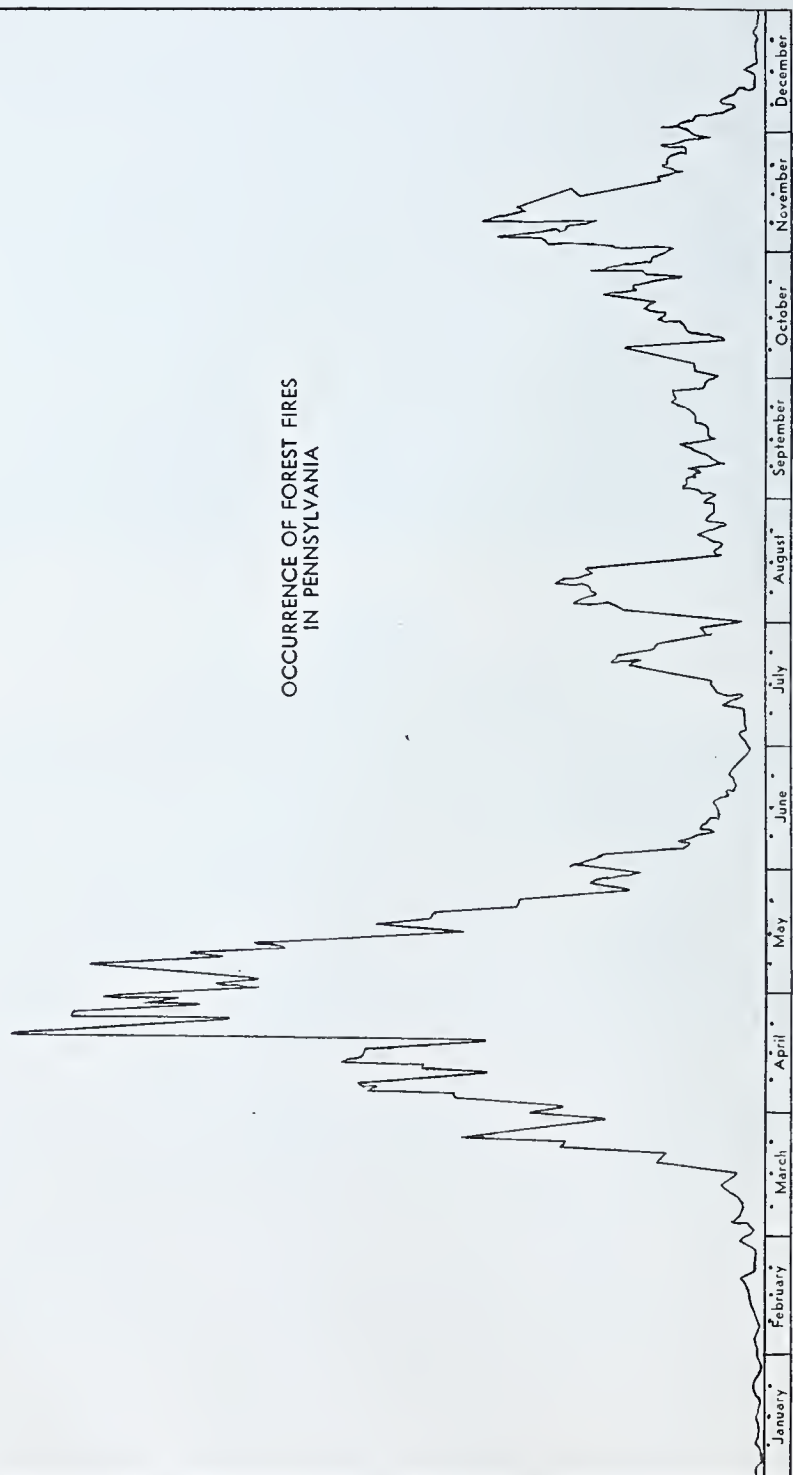
The first thing that must be remembered is that vegetable, or plant material, is inflammable. Some living plants, shrubs and trees burn readily any time a spark of fire comes in contact with them. Other vegetable matter becomes burnable only after it dies and dries, at least, in part. But when dry, vegetable material burns easily and rapidly. A little fire and heat dry twigs and leaves to a degree that they will ignite readily. Therefore, everyone must be careful with fires where and when plant growth is on the ground, and especially, when such growth is dead and dry.

The ABC of protection from fire is Always Be Careful with fire.

The second thing that should be remembered about forest fires is that fire is not a natural condition in a forest. There is nothing in connection with the growth of a forest that normally results in a fire. It might be possible, under peculiar conditions of weather, for dry branches to rub together and cause a spark. It might be possible, also, under a combination of favorable conditions, for hot, dry vegetable matter to burst into "spontaneous combustion." Such combinations of factors are exceedingly unlikely and unusual and are very rare occurrences.

Lightning fires. Occasionally, lightning strikes a tree, dead snag, or other objects in the forest, and sets a fire, which, when conditions are right, may spread through the forest area. In some parts of the

OCCURRENCE OF FOREST FIRES IN PENNSYLVANIA



country, such fires may be numerous, but in Pennsylvania, the average number of lightning fires per year is twenty-one, based on the records from 1921 to 1940, inclusive. The highest number reported in any year, during the same twenty years, is seventy, and the lowest is three.

The rest of the many forest fires come from some person's individual intention to start a forest fire, or someone's carelessness with fire which he is using for some other purpose. Some of the causes of forest fires are:

Railroad operations:

- Sparks from smokestack
- Sparks from ash pans
- Clinkers from engine
- Smoking material thrown from windows of cars
- Hot brake shoes
- Burning right-of-way
- Burning tie piles

Smokers:

- Unextinguished and discarded matches, cigarettes and pipe heels

Campers:

- Fires built at wrong places—not sufficient bare space around them
- Fires built too large
- Small or large fires unguarded
- Fires abandoned—not extinguished

Lumbering:

- Sparks from engine stack
- Sparks from engine exhaust
- Sparks from smoking material of workers
- Sparks from steel sled runners
- Sparks from burning slab piles

Brush burning:

- Brush piles too large
- Brush piles too close to woodland
- Brush or rubbish burned on windy days
- Fields burned over and fire becomes too much to stop
- Fields or gardens burned to kill weeds and seeds
- Patch burned to get rid of snakes

Incendiarism:

- Someone starts fire to do damage to someone else, or deliberately burns property belonging to someone else in order to benefit himself
- Huckleberry fires
- Deer food fires
- Fires to increase grazing for cattle

Fire to destroy cut wood
Fire to kill trees so that dead wood may be cut
Fire to cover some crime
Fire to draw attention away from some other disturbance

Miscellaneous causes:

Toy balloons
Fire crackers
Dynamiting
House chimneys
Burning buildings
Engines of various kinds, other than of standard railroads and
lumbering
Children playing with matches
Broken power wires

Causes unknown:

This includes a great many fires, the causes of which cannot be determined.

Chapter IV

FOREST FIRE PREVENTION

With some information as to when forest fires are most likely to occur, and as to the common causes of forest fires, it is possible to do something toward the prevention of such fires.

Again it must be remembered that all but a very few fires are caused by human beings. People are careless with fire. The fire loss in America, both in lives and property, is enormous. It is necessary, therefore, in order to prevent fires of all kinds, to deal in various ways with people, as well as with the material conditions which furnish fuel for fires or which make fires possible.

It is commonly recognized that when an individual appreciates the value of life or property, he is willing to do something to protect it. In the case of the forest, therefore, we must know something about the forest and the place it has in our individual, community and national life.

Every individual in a community must be taught in such manner as to learn definitely that forests are of tremendous value to him and to his fellows. If he is a forest land owner, or if he is not, he has a definite responsibility to himself, to his neighbors and to those who come after them. According to our Pennsylvania Constitution, "All men are born equally free and independent and have certain inherent inalienable rights among which are those of defending life and liberty, and of acquiring, possessing and protecting property and reputation, and of pursuing their own happiness." This Bill of Rights implies not only the right, but also, the responsibility of protection of one's property. But, it also implies that responsibility.

ity for the benefit of the general welfare, not only now, but in the future.

This phase of the prevention program calls for the use of all possible means and methods of education for all ages and groups of people throughout the State. Many of the common means and methods of education are not available to the average individual, but personal contacts are possible for everyone interested in spreading the program of forest protection and forest fire prevention.

You can help by taking every opportunity to speak to other people about the value of forests and the necessity of being careful with fire. You can be on the lookout always for signs of possible activities which might lead to carelessness with fire, or to a forest fire. A word of caution given to the person concerned may be sufficient to prevent a fire. Close cooperation with the District Forester will be appreciated.

Because the forest fire seasons in Pennsylvania are pretty definitely defined, the next important phase of forest fire prevention is to help develop the necessity of having a complete blackout of fires out-of-doors during the four months of greatest fire danger, namely, October and November, in autumn, and April and May, in spring.

There are conditions in the forest and near forests which may be corrected so that the possibility of forest fires, or the severity of a fire, may be eliminated, or greatly reduced. For example, along railroads the railroad rights-of-way should be cleaned up, and that is the responsibility of the railroad company, but the land owners adjoining the railroad should plow several furrows parallel to the tracks, or develop safety strips, so that fire from sparks will not start or spread.

Other suggestions are:

- Burn safety strips around sawmill sets
- Stop smoking in woods while moving about
- Discard smoking material only after the last spark is dead
- Build no camp fires, except in safe places
- Keep camp fires small
- Be sure to extinguish your fire before going away from it
- Do not leave any fire unguarded, even for a moment
- Screen smokestacks, exhaust pipes and chimneys
- Burn brush only when snow is on ground, or it is raining
- Cut dead snags and use them to advantage
- Keep forest free from slash, so far as possible
- Lop the brush so that it decomposes rapidly
- Do not let brush be piled along a road or trail
- Keep borders of woods dense. Plant conifers, if necessary.

Keep roads and trails free from debris, and with a strip of bare mineral earth at least one or two feet wide.

Another form of preventive education which many of us forget and dislike, is that of law enforcement. There are some people who are

just naturally careless. They do not consider themselves as doing anything that is disadvantageous to their neighbors but, nevertheless, they do not take reasonable precautions to avoid damaging those about them, and the community as a whole. Such people apparently can be taught their responsibility to the community only by being brought face to face with the requirements of the law. Of course, there can be no question as to the necessity of punishing those who are definitely determined to do harm to another or to the community.

It must be remembered that the damage done by a forest fire is the same, no matter whether it was started from a cigarette thrown away thoughtlessly, or from a candle placed by a criminal intent upon murder. No one knows how much property may be damaged, or how many lives may be snuffed out by a forest fire which started from a mere spark from a fire carelessly unguarded or discarded.

The important thing to remember is that you should not become a thief or a murderer, by reason of your own carelessness, and that you have an opportunity to prevent your friends and neighbors from becoming such.

Chapter V

FIRE BEHAVIOR

Fire burns more rapidly

- In fuel free from moisture
- When amount of fuel increases
- When fanned by wind
- When burning uphill

Some fuels burn more easily and more rapidly than others. Dead vegetable material will burn when moisture in it is reduced to a certain percentage. As moisture is lost still further by heat, wind, temperature, or other cause of evaporation, the intensity of the fire increases. Even live vegetation will burn, if heat is sufficient to start a fire and fire continues to drive off a proportion of water from the living cells.

Wind drives heat ahead of the flames and dries out already inflammable material so that the fire spreads most rapidly in the direction in which the wind is blowing.

Fire burning uphill radiates heat against the vegetable material above it and, consequently, burns more rapidly in that direction.

Dry vegetable material smoulders and holds fire for a long time. Therefore, as long as a spark remains, there is a possibility of flames starting up again. Complete separation of burned from unburned material, or complete soaking of material with water, is essential. Even with complete soaking alone, the water will evaporate, and unextinguished sparks may become alive.

Fire on same day on same hill may burn uphill at rate of eight miles an hour and downhill at only about two miles an hour, or even more slowly.

During the heat of the day, fire may burn briskly, while at night, when wind is low, temperature reduced, and usually, there is more moisture in the air, fire will burn more slowly.

The shape of the fire depends upon all of the factors present and affecting the fire. If all factors were constantly equal, a spreading fire would form a circle, but the least movement of air will drive the flames in the direction it is moving. An increase or decrease of fuel will either increase or decrease the rate and amount of spread.

Every fire creates its own draft, so that it is not long after it has started that the usual parts of a fire are in evidence.

The header, or front, is that part of the fire that is driving forward more rapidly than any other part. More than one header may be developed and may be active at the same time, or at different times.

The side lines, or flanks, are those parts of the spreading fire which extend from the header, or front, and spread more slowly, usually "under the wind."

The rear of the fire is that part which is burning against the wind and is usually spreading at the lowest rate of speed.

The fire line is the actual line of flame, or of burning material.

The burned area is that area over which a fire has already spread.

Most forest fires in Pennsylvania are what are known as "surface fires." That is, the fire consumes the vegetable material accumulated upon the surface of the soil. This material is usually sufficient to produce enough heat to consume, also, many of the small plants which are present, and the tips of branches of larger plants whose branches may be reached by flames. When flames come into contact with evergreen leaves, or needles, these go up with a flash, and the resultant heat kills the entire bush, or tree. If loose bark or dead wood fibers are on trees, flames will run to the tops of trees, and in a group of evergreens, may produce a "crown fire." Occasionally, this is observed in an evergreen plantation. Sometimes, in a young oak forest, dead leaves which hang on, occasionally, until early spring, may produce a crown fire.

If the ground has dried out below the surface mulch of a forest, and a surface fire starts, the dry roots of all plants may burn as far into the ground, as moisture is absent or reduced. Then, we have a ground fire.

Chapter VI

ORGANIZATION OF THE FOREST FIRE FIGHTERS SERVICE

It must be assumed that the effective control of a forest fire will be accomplished by the cooperative efforts of several persons who work together in an organized manner. Fires have been, and can be, extinguished by one individual. Likewise, fires have been, and can be, controlled by a group of individuals working as individuals, and in an untrained and uncooperative manner. But when and where there are persons available, and a disposition to do things right, organiza-

tion, training and cooperation are expected, and the best results can be obtained.

1. *Chief*: There must be one person in charge, as a warden or crew leader. This is so obvious that there need be no argument. He must be one who will demand respect and obedience because of his knowledge, leadership, and the results he can get from his men.

2. *Assistants*: There should be at least one assistant and as many more as conditions warrant. An assistant should be able to serve as a good substitute for the chief, in his absence.

3. *Crew*—definite assignments: Every man should be assigned to definite work, at least until the duties and responsibilities of the job have been mastered. Then, assignments may be shifted.

(a) *Size of crew*: In forest protection, it has been found that a crew of ten men makes a very satisfactory unit for fast and effective work.

(b) *Suggested assignments by units*:

1. Axman (one or two)
2. Rakers (four)
3. Torchman (one)
4. Tankmen (two or three)
5. Rear guard

(c) *Special assignments*:

1. Messenger service
2. Transportation
3. Food and water
4. Equipment
5. Evidence of origin

Small fires can be handled promptly and satisfactorily by one crew, but as conditions demand, more units may be advisable or necessary. Larger fires demand extended organization and more over-head supervision. This should be supplied by the Inspector or the District Forester, either in person or by assignment of some trained person to the particular job that must be done.

It must not be overlooked that when a fire starts, it is a mere spark, then a small flame, and then the fire starts to spread. The sooner one person tramps on the spark or beats down the flame or prevents the spread of the fire at the start, the sooner the fire is extinguished and damage prevented. This means everyone in the community should consider it his duty to respond quickly to any fire out-of-doors which shows any signs of being out of place or out of control.

Volunteer forest fire fighters can be of untold help in forest protection by getting to whatever fires that occur within reach of them, by responding singly or in groups, immediately. If there is the slightest suspicion that help will be needed from the nearest forest fire warden, the messenger assigned for that duty should be dispatched at once.

The regular State forest protection organization is as follows:

Chief Forest Fire Warden

Twenty-four District Forest Fire Wardens (District Foresters)

State Forest Rangers

Inspectors

Tower Men

Local Forest Fire Wardens

Crew Men

The organization of the Forest Fire Fighters Service, which is one of the Civilian Defense groups, is as follows:

State Coordinator

County Coordinator, or Chief

Township, or Local Board Chief

Crew Leader

Crew Members

Chapter VII

FOREST FIRE FIGHTING EQUIPMENT

Fire in the forest has the same characteristics as fire anywhere else. Fire has three factors which must be considered in its extinction, namely, heat, fuel and air. Eliminating one or two of these factors will eliminate the fire.

Many times, the easiest method of controlling a forest fire is to separate burning fuel from unburned fuel. In the case of ordinary surface fires, the following equipment can be used:

The hands of men

Forked sticks with which to scratch a path

Home tools, such as hoes, garden rakes, potato hooks, railroad forks, shovels, brooms of various kinds

Rich rake, the standard tool of the Pennsylvania forest protection organization. It cuts small growing plants, does not fill up with leaves, cuts small roots and digs humus and soil.

In case it is necessary to do more than develop a surface trail with exposed mineral soil, larger equipment may be required—shovels, mattocks, picks, plows, road machines, or bulldozers.

For knocking down flames, which reduces the heat, the following may be used:

Brush, especially a pine branch

Wet bags

Fire swatter

Water, with pump:

Knapsack spray pump—standard Pennsylvania equipment

Small pump on car engine, with booster tank

Portable pump for 1½" hose

Larger equipment

Water is not always available, but where it is, and force can be applied, it is far better than any kind of chemical extinguisher, Fog spray, with force, is best form of water to be used.

Auxiliary tools:

Ax, brush hook or brush shears, for cutting woody growth where firebreak is to be made

Saw, for felling large snags or cutting logs from trail

Torch, for better burning out fuel between original fire and fire-break, and along edge of fire along back lines

Canvas pail and supply tank, for filling spray tanks used on fire line.

General: It is poor practice for an organized fire company to take onto country roads high-priced equipment adapted for use on city streets. Such equipment should never be used on mountain roads. Chemicals should not be wasted on out-of-door fires. Small quantities of water, under pressure, are best to extinguish out-of-door fires.

When flames of a forest fire line have been knocked down by beating, or by the use of water, it should be remembered that many embers will remain hot and unextinguished. It is a standard rule, therefore, that a trail with exposed mineral earth shall be raked completely around the burned area so as to prevent any subsequent outbreaks which may get out of control.

No matter how simple or familiar any of the tools mentioned may be, each one has certain peculiarities which make it effective or worse than useless. A forked stick, for example, can be cut from a sprout near the fire, and with some practice, an energetic man can scrape a fairly clean trail and make fairly good time. Of course, with a sharp Rich rake, he can do much more, but, if he uses a Rich rake as a hoe, instead of as a cutting tool and a rake, he will not make much trail; nor a very satisfactory one.

Also, with the knapsack water tank and trombone pump, much hard work and water can be wasted, if every drop of water is not delivered at effective places, near the origin of the flames. Forest fire tools should be actually used in the forest so that forest fire fighters may learn how they may be used effectively, and for what they may be used.

Chapter VIII

FIRE DETECTION

Next in importance to the actual prevention of forest fires should be listed the prompt detection of those that do occur. This is so because when a fire starts, what happens in the way of damage depends upon the promptness and effectiveness with which it is controlled. The sooner someone, who can control the fire, knows of its existence and where it is, the sooner he can organize his force and get to work.

It is essential for everyone to know that a fire in field or forest spreads over increasingly more and more area as time elapses. In other words, the spread of fire in the second half-hour, after it starts, is several times more than the spread during the first half-hour of its burning. Therefore, prompt detection is necessary.

With a knowledge of the time of year that forest fires occur most frequently, and with a common knowledge that forest fires may occur any day in the year when snow is not on the ground or when it is not raining, it is wise for every person living in and near wooded areas to be constantly on the watch for the first wisp of smoke from a fire out of place.

This watchfulness should become part of the everyday life of everyone in the family, from the youngest to the oldest. The next step in protection of property is that the existence of a fire must be reported immediately to someone in the family or community who can investigate and do what must be done to accomplish the control and extinction of the fire.

In order to protect vast areas of country within which few people live and where means of communication are limited, the Commonwealth has erected one hundred forty-five steel observation towers on the high mountain tops. During the spring and fall forest fire seasons, observers are on the towers, keeping close watch over the forested country. For the most part, the observer lives at the tower, while on duty. At only a few towers, the observers live there throughout the year. It is intended that an observer shall live at each of the towers for most of the year.

With but few exceptions, each forest fire tower has a telephone installed in the observation room at its top. Over one hundred of them have two-way short wave radio equipment, also. The observers are the "eyes" of the protection organization, but it is essential that after the "eyes" have observed smoke, information concerning the existence and location of the smoke must be communicated to the fire extinction force. An observer must be keen, both as to sight and as to ability for getting the information through, and some reaction to it.

Just as soon as people living in and near forested areas assume their responsibility of preventing, reporting and promptly controlling fires in their home territory, the forest fire towers can be closed, except for sight-seers.

Volunteer observers and patrol in time of war, and even in peace time, can help their local people and the Commonwealth very much in the forest protection work.

In order to be able to report a forest fire quickly, there are several simple rules to follow. If a telephone is in a home, there should be posted near the telephone a card with the name and call number of the nearest forest fire warden, as well as the nearest fire company and the family physician. There may also be posted the name, exchange and number of the District Forester. When the local forest fire warden cannot be reached or is not known, and it is

reasonable to suppose that the local warden has not yet been notified or is not at home, call the telephone exchange operator and state that a forest fire is to be reported to the District Forester. The operator will get the Forester on the line, and the toll, if any, will be charged to the State.

If there is no telephone in the home, arrangements should be made to spread the news to the neighbors. Someone should act as a messenger or a group of neighbors should arrange for a community fire alarm of some kind, such as a bell, whistle, siren or, perhaps, a piece of iron suspended properly.

Another arrangement which has been put into effect is a plan for employing Civil Air Patrol pilots and planes for observation over forested areas in case of emergencies. Their use will be an extra protection by affording exact information when the information available, under ordinary conditions, is not complete.

Chapter IX

FIRE EXTINCTION

General Factors for Consideration:

1. Situation upon arrival at the fire
2. Question of reinforcements
3. Fire extinction methods most suitable
4. Utilization of resources—active, auxiliary and supplementary

Specific Factors for Consideration:

1. Sizing up the situation
 - a. Kind of fire—tree, surface, ground
 - b. Location—slope, growth, fuel
 - c. Weather conditions—temperature, moisture, wind
 - d. Values endangered
 - e. Factors favorable and unfavorable for control:
 - Rapidity and direction of travel
 - Fire breaks; points of attack
 - Men and tools
 - f. Life hazard presented, including danger to fire fighters:
 - Fire fighting is dangerous
2. Getting reinforcements, if necessary:
 - a. One man—radio—telephone
 - b. Messenger
3. Extinction of fire:

Operations are dependent upon kind of fire to be extinguished, its location, severity, threats, etc. Consequently, each situation presents an individual problem involving a study of the prevalent characteristics and the most suitable tactics to be employed.

- a. Tree fire. Cut draft, plug with dirt the holes at base, get water into hollow top, cut down, open and extinguish blaze with dirt or water. Tools—shovel, ax, saw, spray tank or other water pump, and water.
- b. Surface fire. A surface fire runs over the litter of the forest floor and burns varying amounts of litter, loose debris and smaller vegetation. Most forest fires in Pennsylvania start as surface fires. Separate burning from unburned fuel. Extinguish flames. Deaden sparks.
 - (1) Locate most rapidly spreading fire. If other men are fighting the fire, they should be contacted at or near the head.
 - (2) Knock down the flames with water, brush or burlap; or backfire from firebreak already available or developed for the occasion; stop the header or squeeze out header by attacking both side lines and rapidly cutting off the flames and consequent heat and draft forcing the header.
 - (3) Take care of spot fires.
 - (4) After header is under control, follow around side lines and rake clean trail so as to separate fuel just outside of burning line of fire.
 - (5) Precautions necessary to see that sparks do not start a new fire:

Beating down the flames may result in slowing down the spread of fire, but burned fuel should always be separated from unburned fuel by a bare earth strip, at least a foot wide, completely around the burned area.

Mopping up snags, stumps, logs, unburned islands along line.

Tools—axes, brush hooks, Rich rakes, torches, spray tanks, pumps, brooms, brush, etc.
- c. Ground fire. Material on surface may or may not be burning. Vegetable material in dried ground will burn as far as it extends. Fire may burn for a distance underground and come to surface at any point. Then, a surface fire may and probably does start.
 - (1) Objective is to extinguish flames on surface and prevent spread of fire below ground, as well as on surface.
 - (2) Procedure is usually the same as in extinguishing a surface fire; then, ditch ground or quarry rock area so as to cut off burning material. Flooding of ditch may be necessary, if water is available;

- otherwise, watchfulness becomes necessary until there is a soaking rain.
- (3) Tools—same as for surface fire; also, shovels, mattocks; and pumper and hose.
- (4) Mopping up.

Methods of Attack:

1. Knocking down flames

- a. Brush. Pine and hemlock preferable to hardwood species. Strike with side stroke, toward burned area so as to sweep burning material away from unburned fuel on burned area and so as not to scatter sparks onto unburned area. Wet burlap, blanket, coat or other material may be used.
- b. Fire Swatter. This equipment may be homemade from old belting and used as a swatter, or may simply be dragged over fire line as in case of grass fire.
- c. Dirt. Sand or soil may be scattered over burning material; cover or dampen it, thus crowding out the air and lessening the flame. It is essential to see that covered embers do not gradually burn to point beyond cover and then break into flames again. Shovels, mattocks, plows, tractors, etc., are useful for this purpose.
- d. Water. From the common knapsack tank, a more or less solid stream can be thrown about forty feet. Such a solid stream, placed at the foot of the flames, dampens the fuel, extinguishes flames and forces burning material back onto burned ground. When shot at foot of flames on burned area side, water will be distributed over unburned fuel and into air spaces of burning vegetable matter. This may be of great advantage, but care must be exercised not to force unextinguished embers onto fuel which may later dry and cause trouble.
The effect of larger and stronger streams from hose attached to power pumps is determined by the speed and effectiveness with which the greater quantity of water under stronger pressure is applied to the fire line.
Where the stream of water can be broken down to the smallest particles (fog) apparently the maximum value may be obtained from plain water as a fire extinguisher. Temperature is reduced, air or oxygen is crowded out, force blows out the flame and separates burning from unburned material.
- e. Chemicals. Chemical extinguishers may be used, if and when available, but their effectiveness is not greater than an equal quantity of water applied with some force. They are expensive and troublesome on account of necessary re-placements.

2. Separating burning from unburned material:

This is accomplished by allowing a fire to burn to an existing firebreak and seeing that the fire stops there or by developing a firebreak and allowing fire to burn to it, assisted, perhaps, by a backfire.

Every forest fire should be completely surrounded, as soon as possible, by a firebreak of not less than a foot of bare soil, water, rock, or other noninflammable material. Usually, this can be accomplished with equipment commonly available, such as a fork, shovel, mattock, garden rake, potato hook, etc. The standard Pennsylvania tool for this purpose is the Rich fire rake. The Rowland trail builder was developed for this purpose and is serviceable where terrain is not too rocky. It is a power machine. Of course, plows and tractors may be used, if available. A power stream of water may also be used but, ordinarily, it cannot be furnished during the time of a running fire.

To stop a header by this method, sufficient space must be provided so that sparks and flames will not start new fires beyond the break. This is accomplished by developing a break at a satisfactory location with respect to the spreading fire and backfiring so that the two fires meet far enough away from the break to effect the extinction of the fire. It is usually dangerous and very uncertain of success to trust a narrow firebreak to stop a header.

Along the flanks of a fire, a narrow firebreak is, as a rule, sufficient to stop fire. The fire may be allowed to burn to the break, or a backfire may be used to lessen the time for burning the fuel desired to be burned. The distance between fire and firebreak depends upon intensity of the fire and the irregularity of the line of fire. The firebreak and backfire must be located so as to save time or area, or both. Frequently, time is worth more than area.

The rear of a fire may be stopped by allowing the fire to burn to a firebreak developed as close to the running fire as is possible. Again, time and space may be saved by shortening the firebreak so as to avoid irregularities in the perimeter of the spreading fire.

In the case of a ground fire, trenching may be necessary. This is simply a firebreak dug deep enough into the ground to stop the spread of fire caused by burning vegetable matter below the surface. The trench may be dug with the use of hands, among rocks, or by using tools, power equipment or a stream of water under pressure. Sometimes, to insure results, a trench may have to be flooded with water.

Chapter X

WELFARE AND SAFETY OF FOREST FIRE FIGHTERS

Fighting forest fires is an emergency job and must be done, but there is no reason for anyone to believe that common sense should not be exercised at every step of the work.

The existence of fire must be detected and reported, but that is no reason for anyone to climb a high power transmission line tower, be-

tween high power wires, to reach a point where a better view of the fire can be had. Extreme care must be used by observers using the forest fire towers. A careless step, taken during bad weather, can cause a fatal fall.

The control forces must get on the move as soon as the alarm of fire reaches them. There are tools to be handled, and some of them are sharp-edged. From the time those tools are assembled to go to a fire, until the time they are re-checked and put away for the next fire, they are dangerous, if handled carelessly. Special care must be exercised in the handling of tools while being transported to, and during actual use on a fire line. The Rich rakes, if improperly handled, may cut the hands, feet or legs of the person using them, or strike nearby workers.

Axes may catch on branches, glance, or fly off the handles. Other tools may also cause accidents, if not used properly. It is essential, therefore, that all tools be used with care, and in a proper manner.

During travel on cars or trucks, forest fire fighters must exercise good judgment. The driver must drive in a safe and careful manner. Pushing and shoving may result in someone's falling from the car. Even in the loading and unloading of a truck, accidents can happen because of careless grips or steps.

It should not be forgotten that fire itself is dangerous. Care must be exercised so that one's clothes do not catch on fire. Crews should be counted, from time to time, to make sure that everybody is accounted for. Fire, driven by wind, may change its course of burning and so endanger persons who are busy fighting it and are not watching for such possibilities. Those in charge of fire fighters are responsible for observing any change in conditions which may endanger those at work.

Frequently, forest fires must be fought at night. Walking through pathless, brushy areas demands the utmost care. Tripping over rocks, roots, logs, and other things in one's way is common. Falling, while using a sharp-edged tool or a spray tank full of water, invariably results in injury; an ankle may be sprained or bones may be broken. A branch may injure an eye.

There are many other dangers that lurk in the woods and along a fire line, which may cause injury, or even lead directly to an untimely funeral, and yet, throughout the years of experience of the protection organization, it is a fact that few injuries to forest fire fighters have occurred, considering the great numbers of persons who have been concerned. Likewise, there have been few deaths caused by fire, in the work of its control, except when reasonable care was not exercised.

Forest protection appears to be a simple matter to many people, but those who understand the conditions in a forest, and who have seen what fire can do, realize that the fire fighter must know something of the dangers involved, and how to avoid them.

For one's own safety, it is important to

Recognize the great possibility of danger

Follow the instruction of the leader of the crew

Know how to use the fire tool assigned

Dress in substantial clothes and shoes which will not catch fire easily

Use the utmost personal care at all times

Avoid becoming frightened or excited

Hit the line hard and get home as soon as the fire is really wiped out.

Chapter XI

COMMUNITY WELFARE

During times of war, there is a general recognition of the necessity for everybody to do what he can for the common welfare. However, that need is just as great during peace times. The Constitution of the United States and that of our Commonwealth were set up in order to establish units of government that would provide for the general welfare. In a democracy, that is the outstanding purpose of government. Likewise, in a democracy, the government arises from the people. The people in each community, therefore, constitute the government, and what they do should, of necessity, be for their own common good.

The protection of forests from fire, at all times, is a community benefit. Most people think of the forest only as common property, until something is to be done to keep fire out of it, or to extinguish a fire which, probably, is the result of someone's carelessness. Then, it seems to be the common idea that the benefit goes to the owner of the forest area, at the expense of the Commonwealth.

Everybody who has anything to do with forest fire prevention and control should be familiar with some facts about forests in order to understand how to help themselves and so that they may inform their neighbors.

In the first place, if a forest area is as it should be, it has upon it a thrifty growing stand of trees, producing and storing as much wood as the area is capable of producing. That annual crop of wood should be, on the average, about 85 cubic feet, or about as much wood as it takes to make a cord of fire wood. In older and better stands, the annual crop may be equivalent to about 500 board feet of lumber.

If the forest stand is such that this annual crop, or more, is being produced, the crops may be harvested or cut, from time to time. Suppose the owner decides to cut and use or sell some wood or timber. If it is cord wood, which is probably the cheapest form of wood, the owner would pay to some laboring man in the community two and a half or three and a half dollars for cutting a cord of fire wood, worth about fifty cents in the tree. If it is lumber, the owner may get from six to twelve dollars per thousand board feet, as it is

in the trees, but somebody in the community will get anywhere from ten to twenty-eight dollars for cutting and manufacturing the trees into lumber. Therefore, the community gets much more out of the wood crop than does the owner of the forest.

Every productive and protected forest area does affect beneficially the climate, and moisture supply in air, soil and stream in the community of which it is a part. The owner cannot possibly get so much from these forest values as do all the citizens in the community, individually and collectively.

The forest areas within our State are, for the most part, open to hunting, fishing and other forms of recreation. Most forest owners do not object to having their property used by any and all who want to enjoy themselves. Common courtesy, of course, demands proper respect for the property of the host. Frequently, the owner cannot or does not use his property for recreation. All forest property makes the country within which it is located a more delightful and beautiful region in which to live or visit. Forest scenery and forest recreation benefit all business in a community because of the money which may be left by tourists. Quite frequently, the owner does not share this prosperity, except in a very indirect way.

Forest land which should be using all the sun, wind and rain which comes to it but which is not doing so because fires keep the trees from growing, or even from starting, is a detriment and may be an actual menace to a community. The beauty of a mountain or valley may be destroyed. The moisture of the region may be lost. Soil erosion may damage fields, gardens, stream beds, transportation and communication lines, and so on. Game and birds may disappear. Recreational conditions may be entirely absent and, of course, no wages can be obtained from trees which have not grown into fire wood or log size.

Forest protection, therefore, is a community welfare proposition in order to prevent calamities and in order to develop all the benefits which can flow from productive forests.

The protection of forests from fire must become a continuous community program, not only during a war period, but for all time.



